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Unified Theory of Inertial Granular Flows and Non-Brownian Suspensions MATTHIEU WYART, nyu, ERIC DEGIULI, NYU Physics, EDAN LERNER, university of amsterdam, GUSTAVO DURING, Pontificia Universidad Catlica de Chile , WYART GROUP TEAM — Rheological properties of dense flows of hard particles are singular as one approaches the jamming threshold where flow ceases, both for aerial granular flows dominated by inertia, and for over-damped suspensions. Concomitantly, the lengthscale characterizing velocity correlations appears to diverge at jamming. Here we introduce a theoretical framework that proposes a tentative, but potentially complete scaling description of stationary flows. Our analysis, which focuses on frictionless particles, applies {\it both}to suspensions and inertial flows of hard particles. We compare our predictions with the empirical literature, as well as with novel numerical data. Overall we find a very good agreement between theory and observations, except for frictional inertial flows whose scaling properties clearly differ from frictionless systems. For over-damped flows, more observations are needed to decide if friction is a relevant perturbation or not. Our analysis makes several new predictions on microscopic dynamical quantities that should be accessible experimentally.

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